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None

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UK CL (Edition K) F4S, F4W
INT CL[5] F24H

(54) Radiant and convected air heating apparatus

(57) Electrical heating apparatus comprises radiant heating elements (3), a reflector (15) for radiating heat through an air opening (9), and a fan (13) which draws cold air downwardly over the elements (3) and expels heated air through exit (11). In a preferred embodiment, the front edge (32) of the reflector (15) is spaced from an upper wall (33) to define an auxiliary air inlet (34). This promotes air flow in the space between the back of the reflector (15) and a rear wall (35) to assist in cooling the reflector and scavenging otherwise waste heat.

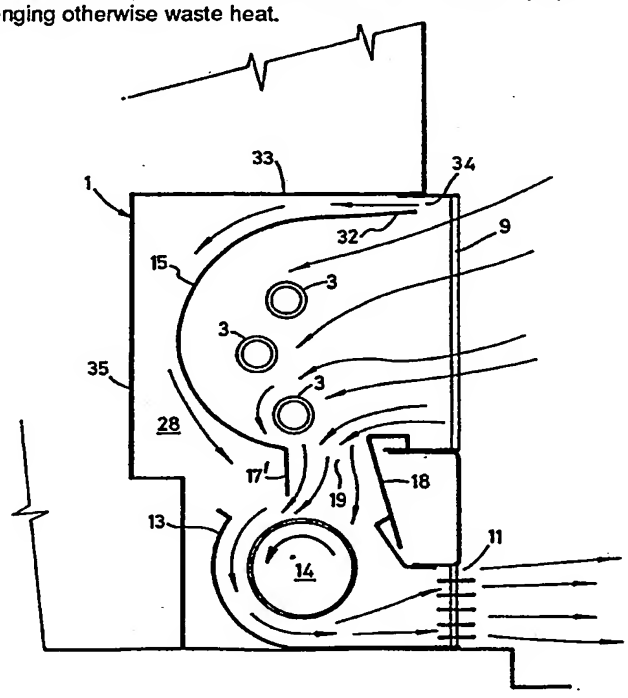

Fig. 5

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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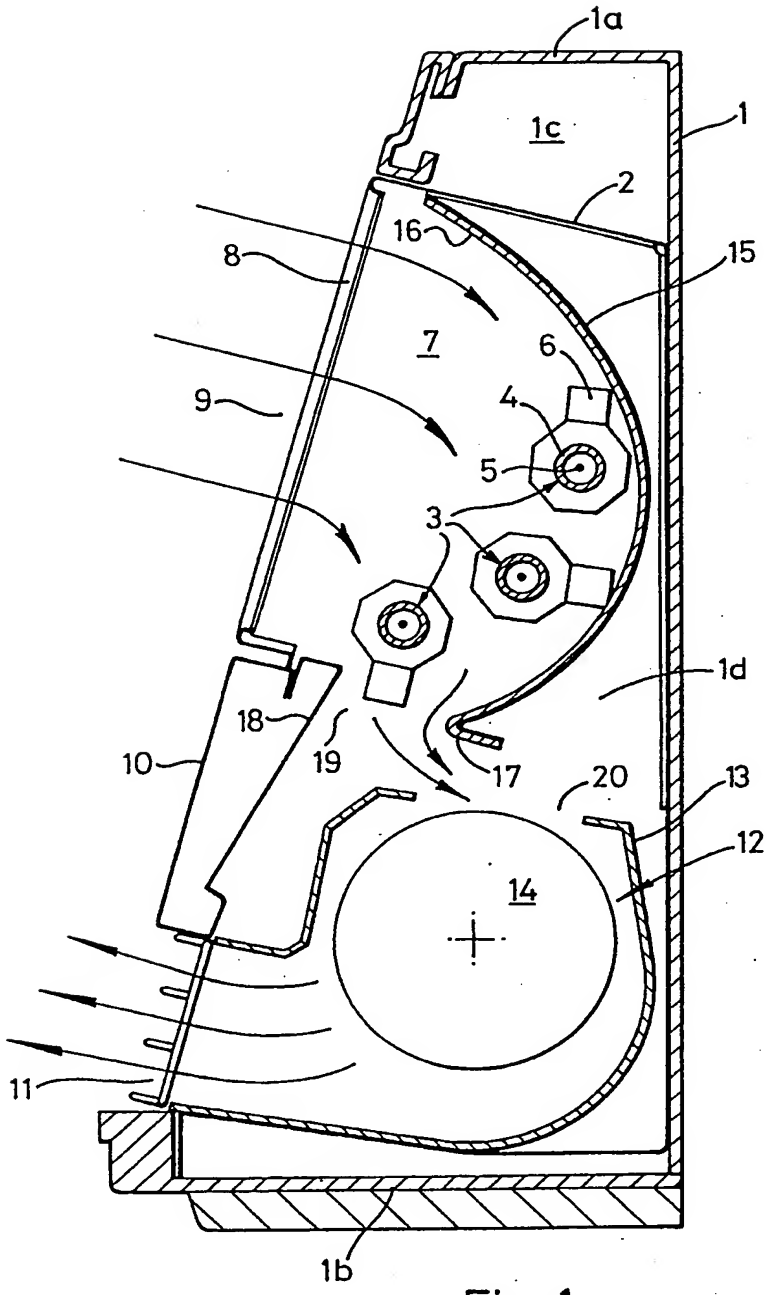


Fig. 1

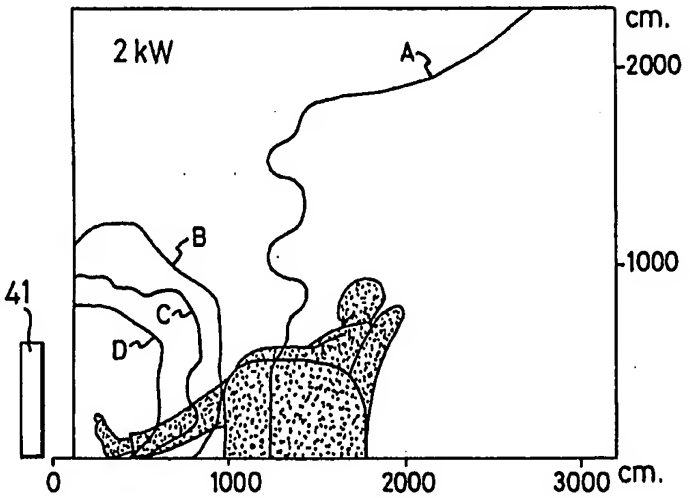


Fig. 2a

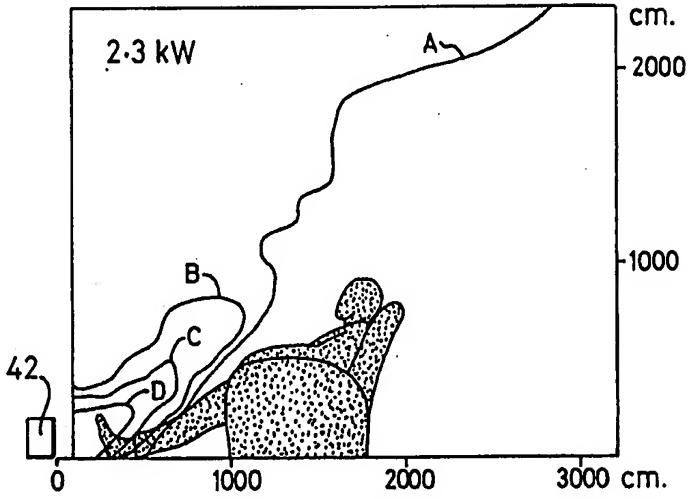


Fig. 2b

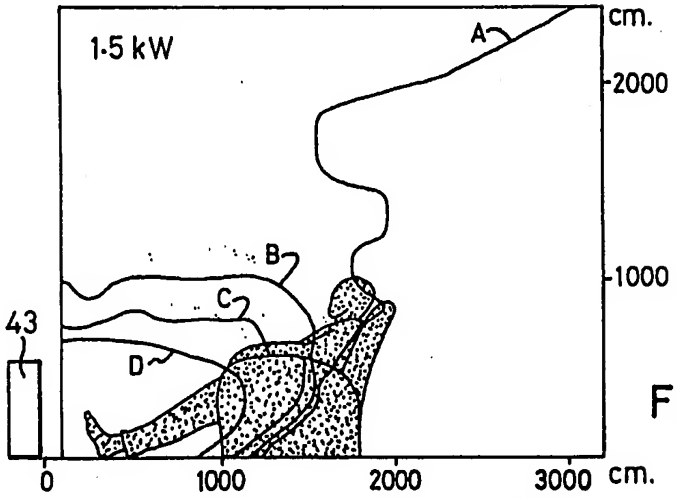


Fig. 2c

A ⩾ 22°C
B ⩾ 25°C
C ⩾ 27°C
D ⩾ 30°C

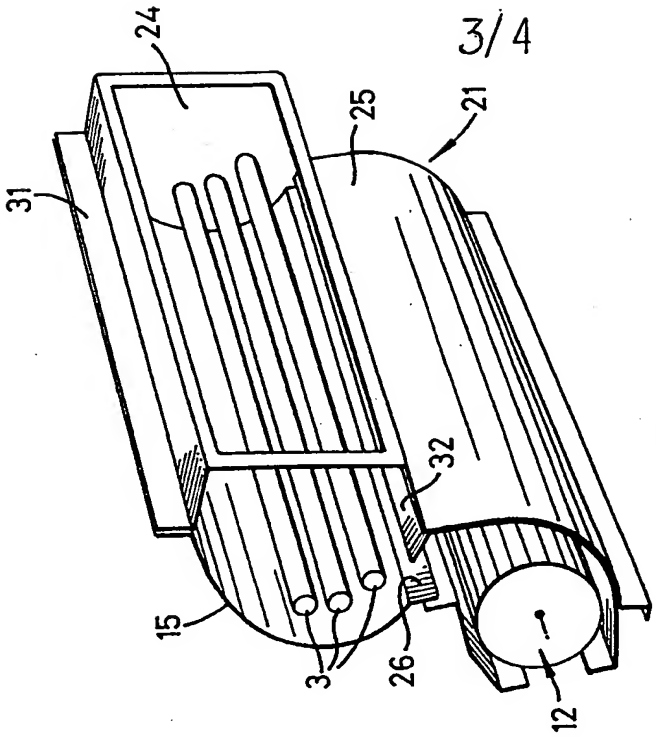
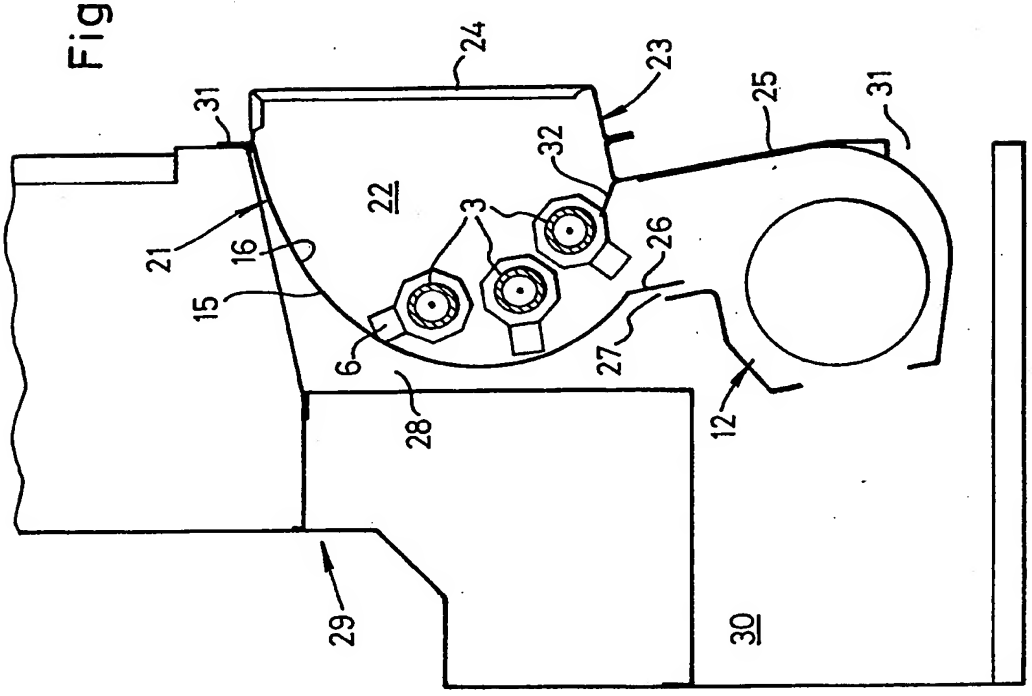

24
25
21
31
32
15
3
26
12

Fig. 4

Fig. 3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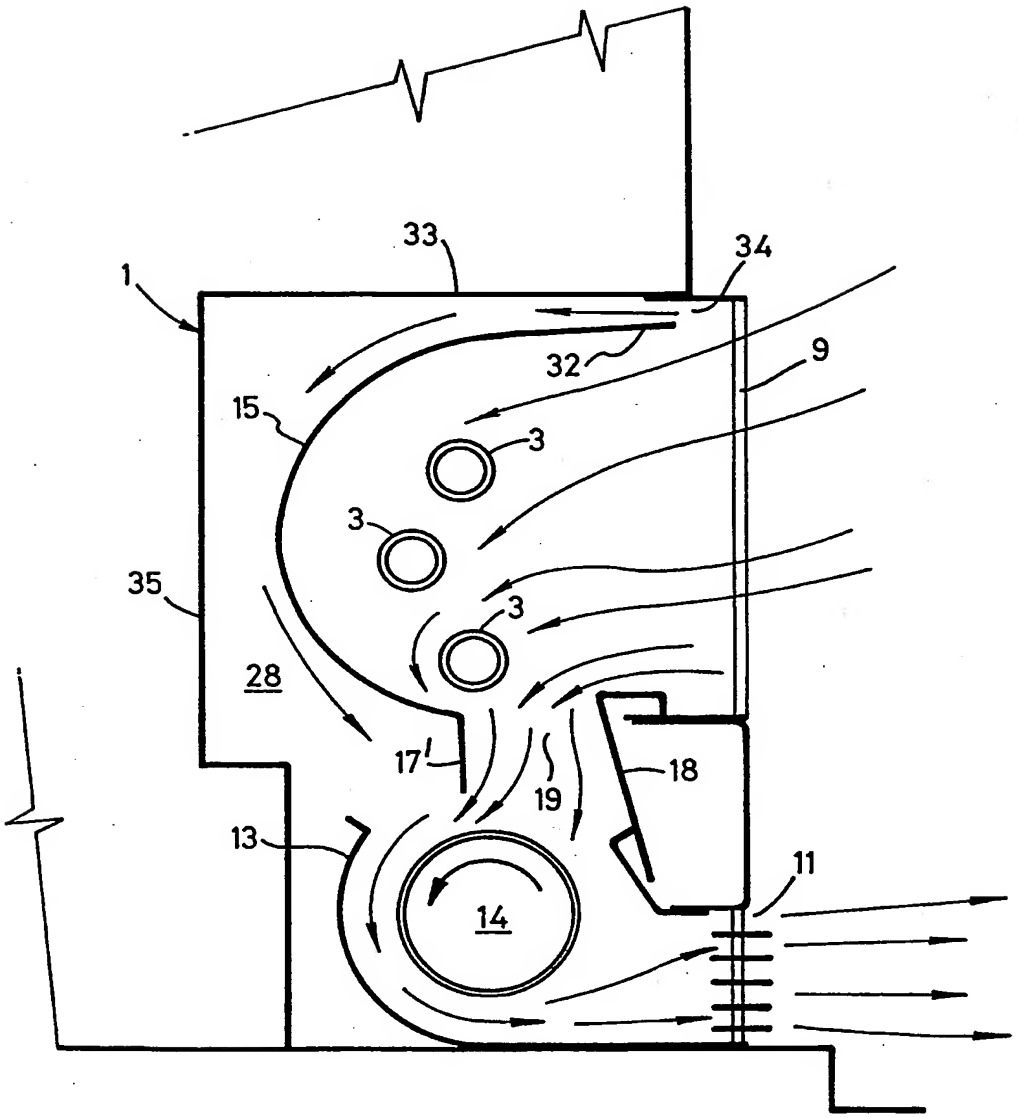

Fig. 5

RADIANT AND CONVECTED AIR HEATING APPARATUS

This invention relates to apparatus for providing radiant and convected air heating in which the distribution of heat is improved, particularly adjacent floor level. An embodiment of the invention also enables a radiant and convected heating module to be fitted to different designs of electric fires and/or fire surrounds.

GB 2 075 665 describes an electric fire for providing radiant and convected air heating. The radiant heat is provided by heating elements mounted adjacent a reflector which radiates heat through a first air exit at the front of the fire. A fan is mounted behind the reflector so as to provide a stream of air which first impinges on a rear surface of the reflector and then diverges over upper and lower surfaces of the reflector in order to keep the reflector cool. One of the divergent streams passes through a second exit, above the reflector, and emerges as an upwardly directed stream. The other divergent stream of air passes forwardly underneath the reflector and is then deflected rearwardly, by a baffle, towards the heating elements before passing out of the first air exit into the room. This arrangement has at least the following disadvantages.

The air flow from the exit of the fan first impinges on the back of the reflector, then diverges and then follows tortuous paths before emerging from the two air exits. These air streams are thereby subject to fluidic resistance and this can diminish the force of air entering the room. This can lead to a poor distribution of convected air which is directed into the room adjacent floor level and this affects the comfort of the user. If the distribution of convected air is poor, the apparent response of the fire is also slow, i.e. when the fire is first switched on, it does not appear to provide a rapid output of heat.

The fan is fitted into part of the main housing of the main body of the fire. Its exit is spaced from, and opposite a rear surface of the reflector and a heating element assembly which is fitted to the front of the fire. The process of assembly therefore involves building various components into the fire and this is time consuming and adds to the cost of production. The process of assembly will also depend on the design of the fire and this places limitations on design.

GB 2144843 describes a multi-mode fan heater in which a single radiant heating element is mounted in front of a row of slots (32) in the middle of a reflector (22). A fan (26, 28) is mounted at the back of a casing between the reflector (22) and a rear wall of the casing. In one embodiment (Fig. 2), an air filter (44) serves as a air inlet, and the fan operating mode of the heater mainly involves a forward flow of air past the heating element, out through the slot (32) and the radiant heat opening of the casing. In this embodiment, auxiliary slots (34) provides some return flow of air to heat a sensing element of bimetallic means (36) which control the heating element (20). In another embodiment (Fig. 3), the fan motor (28) is mounted at the back of the casing and a fan (26') draws air through the slots (31), so that heated air is discharged through an outlet (42) under the front edge of the reflector. In either of these embodiments, a disadvantage of providing slots in the middle of the reflector, is that the air flow is concentrated in the region. This may cause the heating element to be dull and thereby produce a poor radiant output. Moreover, the air flow tends to pass directly into the central slots, rather than passing along the surface of the reflector and it does not cool the reflector efficiently or pick up waste heat which could otherwise be distributed into the room. A further disadvantage of arranging the motor in the back of the casing is that the front-to-back dimension of the heater is increased. Also, since the reflector is closely adjacent

floor level, it tends to direct a beam of heat upwardly rather than outwardly into the room.

According to the invention, electrical heating apparatus comprises:

radiant heating means including a reflector having a front surface for reflecting radiant heat and at least one heating element positioned adjacent said front surface,

housing means in which said radiant heating means is mounted, said housing means including a front wall structure which defines a forwardly facing opening for the reflected radiant heat, and a side wall structure which, together with the reflector, defines a space in which said heating element or elements are mounted, said front wall structure having a forwardly facing air outlet, said radiant heat opening serving as an air inlet, and said air outlet being positioned to below said opening and being arranged for discharging air into a room substantially at floor level,

fan means mounted in said housing means below said radiant heating means, said fan means being arranged to cause air to be drawn into said opening, whereby the air is heated by said radiant heating means and then drawn downwardly to be discharged through said air outlet, a channel being provided between said reflector and said front wall structure to enable direct and unimpeded communication between the fan means and the space in which said heating element or elements are mounted.

The latter arrangement works inversely to most known fan-assisted convected air heaters which blow cold air towards radiant heating means and then out through an exit. In accordance with the invention, the air heated by the radiant heating means is not only drawn into the fan before being discharged from the air outlet, but is also drawn downwardly, through the channel between the reflector and

the front wall structure, which enables direct and unimpeded communication between the fan means and the space in which the heating element or elements are mounted. This has a surprisingly good effect on the distribution of heated air in a room, particularly at floor level, which improves user comfort and provides a fast apparent response when the electrical power is switched on. Since the fan communicates directly with the space in which the heating elements are mounted via an unimpeded channel, fluidic resistance is low and this improves the flow of heated air into a room. The incoming air also tends to pass around a greater surface of the reflector which has the advantage of keeping the reflector cool besides picking up waste heat which can be usefully distributed, by the forced convection of the fan, into the room.

Preferably, the reflector, which may be made of sheet material with a polished front surface and of a parabolic shape to produce a beam of radiant heat, has a lower edge which is spaced from an internal wall of the housing means so as to define the channel. In this case, the front wall structure of the housing means includes a panel between the radiant opening (air inlet) and the air outlet. An internal wall or baffle of the front wall structure may be positioned opposite the lower edge of the reflector and spaced therefrom that the channel has a width comparable with the outside diameter of, e.g. a radial fan blade assembly driven by the motor of the fan. The tangential blade structure is preferably mounted in a casing which has an outlet adjacent the air outlet of the front wall structure and an air inlet adjacent the channel. In this case, it is preferred that air is also drawn into the fan from a space between the rear surface of the reflector and the rear wall of the housing. This assists in scavenging waste heat from the rear of the housing which would otherwise be lost towards the rear of the heating apparatus, particularly when installed in a fireplace opening. This scavenging effect may be improved by spacing the upper front

edge of the reflector from an upper wall of the housing so as to define an auxiliary air inlet for air which is induced by the fan to flow between a rear surface of the reflector and the rear wall of the housing. A particular advantage of this arrangement is that the reflector runs cooler, more waste heat is scavenged and the temperature of the air leaving the air outlet is comparatively cooler, e.g. adjacent an air outlet grille. By suitable design of the air flow channels, and the fan, the volume of air flow is maintained to provide a useful distribution of heat at floor level.

In a preferred embodiment, where the reflector is made of sheet material, a lower edge of the sheet is folded downwardly so as to depend towards and/or into the fan casing inlet so as to divide the air flow into the fan casing inlet.

In a preferred embodiment of the invention, a plurality of heating elements are mounted in the radiant heating space and a first one of these elements is positioned adjacent the channel so that it can intercept more of the air flow entering the channel which is drawn downwardly by the fan. This element can be selectively switched on and off to increase and decrease the amount of the convected air output. The other element or elements are positioned adjacent the front surface of the reflector and above the level of the first element so as to provide more radiant heat.

The radiant heating means, the fan means and the housing means may be either fitted integrally to a fire and/or fire surround, or they may be fitted together, as a module, for assembly into an electric fire and/or fire surround. One advantage of the latter arrangement is that it enables a radiant and convected air heating module to be fitted to different designs of fires. This facilitates assembly and mass production and results in a cost saving.

The module may include means to facilitate its fixture in a recess in an electric fire or fire surround. For example, the fire may have a surround which includes an imitation fuel and/or flame effect and a recess, beneath the fuel and flame effect, to receive the module. The fixing means may comprise flanges, tabs, wall parts, snap fittings or mixtures of the same which can be attached to the structure surrounding the recess.

The fan casing may be suspended from the reflector or separately fitted in the housing.

Generally, the heating elements are preferably of a kind in which a wire element is encased in tubing. The tubing prevents the wire elements from being directly cooled by the air flow hence maintaining a better temperature for radiant heat. Although the radiant heating element or elements are cooled by the incoming relatively colder air drawn into the fan, they are preferably operated at sufficient temperature to radiate heat directly into the room so that radiation is visible to and felt by the user. In this way, the air flow does not diminish the effective radiating temperature of the heating elements.

An embodiment of the invention will now be described with reference to the accompanying schematic Drawings in which:

Fig. 1 is a side elevation, in section, of a first embodiment of the invention,

Figs. 2a-2c respectively illustrate the heat distribution from a conventional radiant fire, a conventional fan heater and an embodiment of the invention,

Fig. 3 is a side elevation, in section, of a second embodiment of the invention,

Fig. 4 is a perspective view of the module shown in Fig. 3 with side panels removed,

Fig. 5 is a schematic side elevation, in section, of a further embodiment of the invention.

Referring to Fig. 1, electrical heating apparatus comprises housing means having an outer casing 1 (shown in sectioned lines) and an inner casing 2 (sectioned but shown in solid lines). The outer casing includes top and bottom portions 1a, 1b and side portions 1c which together define a recess in which the inner casing 2 is received. The inner casing is of a modular construction so that it can be independently manufactured and fitted to outer casings (i.e. fires and/or fire surrounds) of different designs. Alternatively, the inner casing and/or its components are integrally fitted to a fire or fire surround.

Mounted in the inner casing 2 are radiant heating elements 3, each comprising a tube 4 in which a wire element 5 is axially supported. The tubular elements are supported by mounting means 6 secured to side walls 7 of the inner casing 2. A front wall structure 8 defines an air inlet 9, a mid-portion 10 and an air outlet 11. A grille (not shown) would normally protect the inlet 9. Also mounted in the inner casing 2 is a fan 12 which includes a fan housing 13, a radial fan blade assembly 14, which extends across the width of a channel 19, and a motor (not shown), the motor being electrically connected or orientated so as to cause the fan blade to draw air into inlet 20 and to expel the air at outlet 11. The fan 12 is of conventional construction.

The inner casing 2 also contains a curved reflector 15 with a reflecting front surface 16 adjacent elements 3 and opposite air inlet 9. The front wall structure 8 defines the forwardly facing opening (or air inlet) 9 which enables radiant heat to be reflected outwardly into the room. The reflector 15 has a lower folded edge 17 which is spaced from

an internal wall 18 of casing 2 so as to define a channel 19 for the air which is heated by the elements 3 and then drawn into an inlet 20 of the fan housing 13 before being expelled by the fan blades through air outlet 11. The inlet 20 may also communicate with air spaces 1d, at the rear of reflector 15, so that some colder air may be drawn in (via leakage through the inner casing 2) to assist in scavenging waste heat from the rear of the reflector and the rear of the casings.

The arrows show the directions of incoming and outgoing air streams whereby air is heated by the elements 3 and the hotter parts of the reflector 15 before being drawn into the fan housing 13 and expelled from exit 11. As mentioned above, the temperature of the elements 3 is lowered, but not diminished below a useful radiating temperature, and the incoming air cools the reflector and scavenges otherwise waste heat at the rear of the casings. The cold air flow through the inlet 9 also helps to keep down the temperature of any guard grille (not shown) which is advantageous in view of protecting the hands or clothing of users. As the fan 14 communicates directly with the space in which the heating elements 3 are located, i.e. via channel 19, and as the fan blows air directly out of the exit 11, the fluidic resistance is lowered, hence improving the distribution of heat, particularly at floor level.

Figs. 2a-2c respectively show a comparison between the heat distribution of a conventional 2 kW radiant fire 41, Fig. 2a, which has only a radiant output; a conventional 2.3 kW fan heater 42, Fig. 2b (i.e. which has a convected air output and no radiant output; and a 1.5 kW fire 43 embodying the invention, Fig. 2c. A surprisingly good improvement in the amount of forward and laterally distributed heat is provided by the invention. Not only can this be seen by the temperature contours A-D, where A // 22°C, B // 25°C, C // 27°C and D // 30°C, but it will also be noted that the fire embodying the invention uses less

power for this result. The lateral distribution of heat is not shown in Figs. 2a-2c but, with the invention, it can extend at approximately 45° on each side of a centre line. In contrast, the radiant heat and the convected air output of conventional fires is usually channelled into a narrow region directed along the centre line.

Referring to Figs. 3 and 4 which illustrate a different embodiment, a module 21 comprises a reflector 15 having a reflecting surface 16 adjacent three heating elements 3 (similar to heating elements 3). The elements 3 are supported by mounting means 6 which are secured to side walls 22. A front wall 23 defines an air exit 24 and includes a lower portion 25. Portion 25 together with a lower portion 26 of the reflector 15 provide a mouth which is connected to the exit of a fan 12. The housing of the fan 12 may be secured to portion 25, or the portion 26 of the reflector, or preferably to both. It is beneficial to provide a small gap 27 between a rear edge of the fan housing and the portion of the reflector so that air circulates in a cavity 28, in the fire surround 29 in which the module 21 is installed, to assist in keeping the rear of the reflector 15 cool. An air chamber 30 is present in the bottom of the fire surround 29 so that air can circulate in the chamber 30 so as to assist in cooling other rear portions of the surround 29. The otherwise waste heat is scavenged from the cooled surfaces and contributes to the thermal output.

The fire surround defines a recess in which the module 21 is received. The module incudes flanges 31 which enable it to be fitted and secured to the surround.

A guard or grille (not shown) would normally be fitted to the frame of the air exit 24 to prevent the elements 3 from being touched. This has been omitted from the Drawings for greater clarity.

The apparatus shown in Fig. 1 can be modified for use as a ceiling-mounted heater if it is mounted upside down.

Fig. 5 schematically illustrates a further embodiment, in sectional elevation. This is similar to the embodiment shown in Fig. 1 except for the following differences. An upper edge 32 of the reflector 15 is spaced from an upper wall 33 of the housing 1 so as to define an auxiliary air inlet 34. Air, induced by fan 14, flows into inlet 34 and then into a space 28 between a rear surface of the reflector 15 and a rear wall 35 of the housing 1. This air flow assist in keeping the reflector 15 cool as well as in scavenging otherwise waste heat from the rear of the heater.

The lower edge 17' of the reflector 15, depends downwardly into the air inlet of fan casing 13. This divides the air flow, so that part of the flow arrives from channel 19 and part from space 28.

In this arrangement, the air flowing out of the outlet 11 is comparatively cooler, although the throughput of air is such as to provide a useful component of convected heat at substantially floor level. Typical air outlet temperatures (measured adjacent the air outlet grille 11) are

55°C with a single element 3 switched on
88°C with two elements 3 switched on
110°C with three elements 3 switched on

The lower element 3, which is more in the air flow, can be selectively controlled to increase or decrease the convected air output.

CLAIMS:

1. Electrical heating apparatus comprising:

radiant heating means including a reflector having a front surface for reflecting radiant heat and at least one heating element positioned adjacent said front surface,

housing means in which said radiant heating means is mounted, said housing means including a front wall structure which defines a forwardly facing opening for the reflected radiant heat, and a side wall structure which, together with the reflector, defines a space in which said heating element or elements are mounted, said front wall structure having a forwardly facing air outlet, said radiant heat opening serving as an air inlet, and said air outlet being positioned to below said opening and being arranged for discharging air into a room substantially at floor level,

fan means mounted in said housing means below radiant heating means, said fan means being arranged to cause air to be drawn into said opening, whereby the air is heated by said radiant heating means and then drawn downwardly to be discharged through said air outlet, a channel being provided between said reflector and said front wall structure to enable direct and unimpeded communication between the fan means the space in which said heating element or elements are mounted.

2. Apparatus according to Claim 1, wherein the reflector includes a lower edge which is spaced from an internal wall of said housing means so as to define said channel.

3. Apparatus according to Claim 2, wherein the reflector is a sheet of material spaced from a rear wall of the housing means, and the fan means includes a radial blade structure mounted in a casing, said casing having an outlet adjacent the air outlet in the housing means and having an

air inlet adjacent said channel, a lower edge of the reflector being positioned above the inlet of the fan casing so that air is drawn into the fan means from both the channel and from a space between a rear surface of the sheet reflector and a rear wall of the housing means.

4. Apparatus according to Claim 3, wherein the lower edge of the reflector sheet is folded downwardly so as to depend towards and/or into the fan casing inlet whereby the air flow into the fan casing inlet is divided.

5. Apparatus according to any of the preceding Claims, wherein the reflector is spaced from an upper wall of the housing means so as to define an auxiliary air inlet for air which is induced, by the fan, to flow between a rear surface of the reflector and a rear wall of the housing means.

6. Apparatus according to any of the preceding Claims, wherein said a plurality of said heating elements are provided, a first one of said elements being positioned adjacent said channel and below the other elements.

7. Apparatus according to any of the preceding Claims, wherein said reflecting surface is curved so as to radiate a beam of radiant heat.

8. Apparatus according to any of the preceding Claims, wherein the radiant heating means and the fan means are fitted together for modular installation.

9. Electrical heating apparatus substantially as herein described with reference to Fig. 1, or Figs. 3 and 4, or Fig. 5 of the accompanying Drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9122799.1

Relevant Technical fields

(i) UK Cl (Edition K) F4W; F4S

(ii) Int Cl (Edition 5) F24H

Search Examiner

A N BENNETT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

19.12.91

Documents considered relevant following a search in respect of claims 1

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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